

Vance (R. A.)

THE TREATMENT
OF
PARALYSIS

BY
HYPODERMIC INJECTIONS OF STRYCHNIA.

BY
REUBEN A. VANCE, M. D.,

ASSISTANT TO THE CHAIR OF DISEASES OF THE MIND AND NERVOUS SYSTEM IN THE
BELLEVUE HOSPITAL MEDICAL COLLEGE, AND ATTENDING PHYSICIAN
FOR DISEASES OF THE NERVOUS SYSTEM AT THE OUT-
DOOR DEPARTMENT OF BELLEVUE HOSPITAL.

[FROM THE JOURNAL OF PSYCHOLOGICAL MEDICINE, APRIL, 1870.]

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*Present by
A. E. M. Purdy*

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THE
TREATMENT OF PARALYSIS
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THE preparations of *nux vomica*, especially its principal alkaloid, strychnia, have occupied a high position among the recognized remedies for paralysis, since M. Foquier, reflecting upon the physiological demonstrations of Magendie, first ventured to test their therapeutical efficacy in cases of this description. In modern treatises on the practice of medicine, as well as in the more special contributions to nervous diseases, rules will be found to regulate their administration, and cautions are given to prevent their use in unsuitable cases.

The first reference to the employment of strychnia

by means of hypodermic injection, was made by Dr. Behier, of Paris, in a paper read before the Imperial Academy of Medicine in 1859, in which he referred to its use in seven cases of paralysis, four of which were cured, and three improved.

In 1863, Prof. Courty, of Montpellier, reported three cases of facial paralysis, and one of paraplegia cured by strychnia administered in this manner.

The article of Mr. Charles Hunter, late surgeon to the Royal Pimlico Dispensary, which appeared in the *British and Foreign Medico-Chirurgical Review* for April, 1868, was the most valuable, as well as the most accessible, of all the contributions to our knowledge of this subject made to that date. In this paper, Mr. Hunter pointed out the advantages and disadvantages of administering strychnia by the cellular tissue, and, from his practical experience, indicated the different action to be expected, when used in the former manner, from its usual effect when given by the stomach. Reasoning from the difference in action of certain other remedies, as morphia and quinia, according as they are given in one or the other of these ways, he stated that we might fairly anticipate a beneficial result in a shorter time, and from smaller doses, when strychnia was administered hypodermically, than when given by the stomach, and that benefit might be expected, even in cases where it had been taken internally without effect.

These *a priori* inferences he submitted to practical demonstration, in the seven cases forming the basis of his communication. Four of these were examples of hemiplegia; one of local paralysis, from injury of arm, and one case of paraplegia, with symptoms seemingly of myelitis. The other case occurred in the person of a

young female, complaining of gastric irritation, weakness, and debility of the spine, and muscular jactitation, who was greatly relieved by several injections.

Dr. M. Gonzales Echeverria, of this city, read a paper on the "Treatment of Paralysis by Hypodermic Injections of Strychnine, with remarks on Infantile Palsy," before the Annual Convention of the Connecticut State Medical Society, held at New Haven, in May, 1868. This paper was published in the proceedings of the Society for that year, and, in addition to the cases in which he details the effects of strychnine injections, contains references to the early use of this remedy by the hypodermic method, to which I am indebted for an account of the researches of the two French physicians before referred to.

In Dr. Bartholow's recently-published "Manual of Hypodermic Medication" will be found an excellent *résumé* of the whole subject, in the section devoted to strychnia.

Having had occasion to use hypodermic injections of strychnia very extensively, during the past fifteen months, in the treatment of the various forms of paralytic affections that have come under my care at the Out-door Department, Bellevue Hospital, I have selected a series of cases which illustrate the phenomena that attend their administration, and indicate the class of cases in which they are likely to prove efficacious. I could have added a much larger number of cases, illustrating a greater variety of diseases, in which the hypodermic injection of strychnia has been employed, either as an adjunct to other methods of treatment, or as the only remedy used, but I have restricted myself to cases in which treatment has been suspended, and in which definite results have been obtained solely by this method of treatment.

As the three prominent divisions of paralytic affections—hemiplegia, paraplegia, and local paralysis—are each represented by several examples, the following cases will be grouped together according to the region of the body affected, and without regard to the date at which they came under treatment:

CASE I.—J. V., Ireland, laborer, aged forty-two. On the 14th day of September, 1869, while working in 75th Street, noticed a weakness and dragging in his right leg, accompanied by more or less vertigo. These symptoms passed away upon taking a drink of water. He then drove his cart to the river, unloaded it, but was unable to drive back on account of a return of the previous feelings of weakness and vertigo. The right arm was now affected, and, upon attempting to call for assistance, he discovered that he could not speak distinctly. The workmen carried him a short distance and laid him on the ground; but in a few minutes these unpleasant feelings disappeared, and he was able to resume work. These two attacks came on and passed off within half an hour, and in neither instance was there any impairment of consciousness. He had not worked long before an unpleasant sense of general uneasiness compelled him to again leave off and withdraw for air. He retired to a shady place and sat down, but in a few moments the same sensation of weakness returned in the right side, and he fell to the ground. This attack lasted an hour, and during its continuance he was unable to move his right arm or leg, or to articulate distinctly, although he was conscious of all going on around him. Afterward his strength returned completely, as also did his speech, and he was able to give an account of what had befallen him, and to walk to his house, a distance of a quarter of a mile, and as-

cent two flights of stairs to his room. Upon arriving there, was again seized as on the second occasion, with paralysis of the right arm, leg, and organs of speech, and fell to the floor, but without losing consciousness. For four weeks was confined to his bed; had complete motor paralysis of the right arm and leg, some distortion of the face, and so much difficulty in articulation, that it was with the greatest effort he could make himself understood. About the middle of October had recovered sufficiently to get out of bed and walk with the aid of a cane; but, since then, although his general health has been excellent, his paralysis has remained stationary. The leg is more supple, and has regained more power than the arm.

In 1861 had a sore, followed by secondary symptoms. In 1867, was accidentally struck on the nose and severely injured by a hand-ball; soon afterward the soft parts of that organ were destroyed by an ulcer, which was undoubtedly specific.

November 27, 1869, came under my observation at Dr. Hammond's Clinic for Nervous Diseases at the Bellevue Hospital Medical College, where he had been directed to apply for treatment. At that time there was a little distortion of the face, the angle of the mouth drooping on the right, and being drawn beyond its proper position on the left side. No trouble with the eye. The tongue pointed to the right side and was very tremulous. He said that the paralysis of the face, as well as the difficulty in articulation, had undergone marked improvement during the preceding six weeks. The shoulders were on the same line, but the right arm was adducted and rotated inward, the elbow semi-flexed, and the forearm rested on the abdomen. The wrist and fingers were slightly flexed, and the hand

was held midway between pronation and supination. Quite an appreciable resistance was met with in attempting to straighten the arm, and he said that this limb had been more or less stiff since he was able to get out of bed, about the 15th of October. The right leg had improved a little since he began to walk, but was still quite weak and numb. He could flex the thigh upon the abdomen when lying on his back, but the power of moving the foot in any direction was completely lost. In walking, he would throw the weight of the body on the left leg, tilt the pelvis, and carry the right foot forward by a movement of circumduction—a manœuvre quite common with hemiplegics. The right toe dragged on the ground at the beginning and end of each step, and he said that the corresponding part of that shoe required cobbling almost every week. The paralyzed limbs were as warm as the healthy ones, and their muscles responded as readily to the induced current. No difference in tactile sensibility between the two sides, and pinching or pricking the skin caused as much pain in the paralyzed as in the healthy arm. He complained of an occasional unpleasant sensation of heat, which manifested itself in the diseased side. No implication of thoracic or abdominal muscles.

The amount of muscular power he possessed in his right hand, at that time, was insignificant when compared with that of his left; and, in making pressure, it was impossible for him to keep up the same degree of force from moment to moment. This defect, combined with his inability to extend, abduct, or elevate the right arm, rendered him almost helpless. Such little things as cutting his food, dressing or undressing himself, could not be performed without assistance. He had the greatest difficulty in walking, from his liability to

trip, and getting up and down stairs was almost an impossibility. He could not walk at all after night, or in a darkened room.

In this case no treatment other than the hypodermic injection of strychnia was resorted to, and the patient was under my care from November 27, 1869, until January 26, 1870. During this time he called at my office every Monday, Wednesday, and Friday, and received a hypodermic injection. The amount of strychnia administered each time varied from the fortieth to the twentieth of a grain, and, as he received twenty-four injections, he took about one grain in all.

No sudden change for the better was manifested during the progress of the case; but the improvement was evident from week to week. Once or twice he thought the medicine produced a little headache, but, as this symptom did not appear for hours after the injection, and occurred very infrequently, it was plain that there was no causative relation between the two.

The most constant of the symptoms referable to the remedy was a sense of tingling and smarting, which would last for hours, at the point where the needle of the syringe was passed through the skin, when the puncture happened to be in the diseased arm. All the injections were passed into the loose cellular tissue beneath the thin integument of the anterior surface of the forearms, and were alternately given in the right and left sides. No such sensations followed the injections into the healthy limb.

On several occasions, especially after the maximum quantity was injected, he would experience peculiar feelings about the knee of the affected side, and slight jerkings of the muscles of the right arm.

The first signs of amendment were manifested in the

muscles of the thenar eminence, and were described by the patient as an increased facility in moving the thumb so as to grasp objects. The extensor muscles of the forearm and hand regained power a little later; and last of all came the deltoid, and the muscles of the hypothenar eminence. Along with restoration of the ability to straighten the arm and wrist, he obtained more control over his foot; but power in the lower extremity never returned to the same extent as in the upper, and, when last seen, his mode of progression was much the same as at first; yet, when his attention was directed to it, he could lift the toe and carry the foot forward in a natural manner. He had become so accustomed to swinging his leg when walking, that the movement was executed from preference. Late in December he endeavored to do something at his former business, but had to abandon the attempt. In January he was more successful, and, after working half of each day for two weeks, was able on the 26th, the date of his discharge from treatment, to resume his usual work, and earn full wages.

CASE II.—Mrs. J., forty-two, widow, seamstress. While working at her sewing-machine on the afternoon of the 10th of August, 1868, she suddenly lost the power of moving her left leg, and at the same time experienced a very disagreeable feeling of prickling and tingling in the foot of that side. Imagining that the limb had “gone to sleep,” she arranged her work so as to walk about until the unpleasant sensation would disappear, but, upon attempting to rise from her chair, fell to the floor. During the remainder of the day she lay on the sofa, and had some vertiginous sensations and confusion of thought, but no loss of consciousness. The next morning she discovered the left side of her body

and face was paralyzed, and had great trouble in talking. By the end of a fortnight she improved so as to be able to walk with the aid of a cane, but the paralysis has remained stationary, and she has done no work since August, 1868.

On the 11th of June, 1869, she came to the Outdoor Department of Bellevue Hospital, and related the foregoing facts. There is but little facial paralysis remaining; protrudes her tongue in a straight line, and talks fluently. In walking, swings her left foot around the right. Left arm hangs loosely and dangles when she walks. No rigidity of any muscles. The upper extremity much more paralyzed than the lower. Well-marked anesthesia in the arm—very little in the leg. Electro-muscular contractility normal. Her mental powers, according to her own statement, are much weakened, and she is easily moved to tears. She requires her sister's aid in performing the simplest acts, such as combing her hair, fastening her clothing, etc. Her food has to be cut into suitable fragments before she can feed herself, and all movements are accomplished without aid from her left hand. Instead of being able to earn her living as before, she is completely dependent on her friends, and in many respects requires as much care as a child.

She has been a patient at several dispensaries, and says she has taken strychnine and iodide of potassium in large doses.

This patient received no treatment other than the hypodermic injection of strychnia, the first of which was given June 11, 1869. Each injection was the thirtieth of a grain, and six in all were administered. After the first injection she experienced a general feeling of warmth, more marked in the paralyzed than the

healthy limbs, and a little rigidity of the lower jaw. Strength soon began to return to the muscles of the left hand, and increased power was plainly exhibited by the third injection. She stated that the feeling of warmth, which was especially plain after the first injection, remained in the ball of her thumb after it had disappeared from the balance of her person. She was also conscious of slight jerkings and a tremulous motion in the muscles of the back of her left forearm. Sensibility returned completely by the last injection.

Improvement was rapid from this time forward, and more marked in the upper than the lower extremity. The ability to grasp objects between the thumb and fingers was among the first motions regained; soon afterward she could move the forearm and hand with greater freedom, and, by the time she had received the sixth injection, could perform all the movements with her left hand that were possible with her right, but of course with much less strength and precision. She was discharged June 25th, finding herself able to work her sewing-machine, and thereby gain a livelihood.

CASE III.—M. O'B., Ireland, laborer, aged fifty-six. In August, 1868, was attacked with paralysis, under the following circumstances: After working as usual until noon of the 16th, discovered a loss of power in the right arm, and a sense of numbness in the right leg. This passed away in a short time, and did not interfere with his duties. An hour subsequently, the same feelings returned, but with much greater severity, and he left work and sat down. A short time afterward he was found in an insensible condition, and removed home. He regained consciousness late at night, and found he had no power over his right side. His face was paralyzed on the corresponding side; the

eye turned outward, and was partially closed. He said that the right side of his face was numb, for he was not conscious of any sensation when flies were crawling over it. There was trouble in pronouncing certain words, but no other difficulty of speech.

In September, 1869, he came under my observation, at the Out-door Department of Bellevue Hospital, and at that time there was no difficulty in articulation, no strabismus, and no facial paralysis. The right shoulder was elevated, the arm adducted and rotated inward, the hand pronated, and, as also the fingers, completely flexed. The elbow was semiflexed, and the forearm rested against the abdomen. He was unable to lift the right toe, and, in walking, he swung the right foot forward, in the manner usual with hemiplegics. He managed to get along without a cane, and said that the foot and leg speedily regained the amount of power they then possessed, while the arm has been steadily growing worse. The sensibility, as determined by the aesthesiometer, was normal, and no difference in temperature was perceptible between the two sides. The power of grasping with the right hand was quite considerable, but it was necessary to place the object to be compressed, completely in the palm of the hand. He could not straighten the arm voluntarily, and the limb was of very little use. The muscles responded readily to electricity.

At the suggestion of an acquaintance, he procured a small electrical machine, which he used by placing one pole in the axilla of the diseased side, while he held the other in the right hand, and turned the crank with his left hand. After proceeding in this manner for several months, he became disgusted with electricity, and disposed of his battery.

For thirteen months his paralysis prevented him from working, and during that time he sought relief from all imaginable sources.

The deformity of the right arm was very easily overcome by manipulation, and appeared to be owing simply to the preponderating power of the flexors, which had undergone less change than the extensors. The induced current caused the muscles to contract, and, when they did so, the limb would resume its natural state. They did not appear to have atrophied to any appreciable extent.

The treatment determined upon was daily frictions of the upper extremity with a coarse towel, shampooing of the muscles, and the hypodermic injections of strychnia. The latter was administered on alternate days for five weeks. During the progress of the case, the patient was exhibited to the class attending the preliminary course of lectures at the Bellevue Hospital Medical College, and Dr. Hammond approved the treatment adopted, and prognosticated a successful result.

Fifteen injections were given, and the patient was discharged November 1, 1869. When last seen, the arm had lost the deformity that formerly existed, and, although its movements were weaker and less free than those of the opposite limb, yet he said he experienced no difficulty in performing the arduous labors of his business.

In this case, each injection was the thirtieth of a grain in strength, and the total amount administered was one-half grain. After the first two or three injections, the patient had marked improvement in the power of moving the hand and forearm, but he persistently denied that any *sensations* were excited by

the drug. I inquired in vain for any thing corresponding to the feeling of heat, the fibrillary contractions, diaphoresis, or stiffness about the joints, mentioned by others who had undergone this treatment. He said the only thing he noticed was that his arm was gradually getting better.

CASE IV.—A. H., widow, Ireland, laundress, aged fifty. After performing an unusually large amount of work on the 10th of June, 1869, she was seized with paralysis affecting the right arm, leg, face, and organs of speech. There were no premonitory symptoms, and the attack was accompanied by a slight amount of vertigo only—no loss of consciousness. After resting for about an hour, all these symptoms disappeared, except a little weakness in the leg, manifested by staggering when she attempted to walk. At the supper-table she fed herself as usual, but, before the meal was finished, the paralysis returned with greater severity than before. She was confined to her room for two months, and during this time the right arm and leg were completely useless, the facial paralysis well marked, and considerable difficulty experienced in articulating distinctly.

When she first came under my observation, October 18, 1869, her daughter's assistance was necessary to enable her to walk in the street. The right side of the face was flatter than the left, the cheek hung, the angle of the mouth drooped, and it was impossible for her to inflate the cheeks, or purse up the lips, as in the act of whistling. The tongue deviated to the right, and there was some thickness of speech. The right arm hung motionless by the side, and in walking she carried the right foot forward by a swinging motion. It was impossible for her to pick up small objects, to

grasp with any force, bend the elbow, or perform any manœuvre with the right arm. The power over the leg was more complete; but she could not raise the toes, or bear the weight of the body on that limb alone. The tactile sensibility was greatly diminished—she could not recognize the two points of the æsthesiometer applied to the right forearm, when separated four inches. The sensibility to contact, temperature, and painful impressions, was also very obtuse. The muscles responded readily to electricity, but the contractions were neither energetic nor complete. Her mental powers were greatly enfeebled—loss of control over emotional manifestations especially marked.

She was under treatment one week, and received three hypodermic injections, each containing the one-thirtieth of a grain of strychnia. The improvement was marked from the reception of the first injection, and, after the third, she was in a condition to resume work. The rapidity with which the arm regained power was surprising. After the third injection, she volunteered the statement that on the previous day she had been able to thread a needle and sew; and, to exhibit her newly-acquired strength and dexterity, she performed several manœuvres that were utterly impossible to her a week before.

February 14, 1870. Mrs. H. called at my office this morning. The right arm is as well as it was before her paralytic stroke. In walking, she complains of stiffness in the right lower extremity, but she experiences no trouble in standing, or bearing the weight of the body, on that limb alone. Has worked in the laundry since October 25, 1869.

CASE V.—M. H., Ireland, mason, aged thirty. During the latter half of September, 1869, was con-

scious of a gradually-increasing weakness in his lower extremities, which finally became so severe as to compel him to give up work the 1st of October. At this time his general health was good, his habits regular, and nothing indicated the cause of his trouble. After visiting several dispensaries, and at least one college clinic, he came to the Out-door Department of Bellevue Hospital on the 20th of October, 1869.

At that time the following notes were taken of his case: The motor paralysis affects chiefly the extensors of the legs and feet; the flexors still retain considerable power, as is easily demonstrated by holding his ankle while he endeavors to extend and flex the leg. Tactile sensibility alike on the two sides, and the sensibility to pain and temperature very slightly, if at all, diminished. The fact that both lower extremities are affected with motor paralysis, and that, if there is any diminution of sensibility, it is so evenly distributed over both legs as to render its recognition impossible by comparing the results obtained by using the æsthesiometer at corresponding points on the two sides, renders it difficult to clearly determine, or completely exclude, the existence of a certain amount of anesthesia. There is no pain referred to the back, and none can be elicited by forcibly percussing the spine. No sense of constriction about the chest or abdomen, no implication of bladder or rectum, and no alkalinity of the urine. No referred sensations, such as formication, tingling in the toes, feelings of heat or cold, etc. No cramps in the legs. Heart and lungs normal. An ophthalmoscopic examination, made that evening, revealed nothing abnormal about the optic nerve or retina. Upon the application of electricity, a certain amount of diminution in the electro-muscular contractility and sensibility was very apparent.

When he is directed to walk with his eyes closed, he staggers from side to side, keeps his feet wide apart, and his arms extended as balancing-poles. He can stand perfectly well with his heels and toes together, and his eyes shut; for, as he says, when he goes to fall his knees rub together, and he appreciates his loss of balance, and rights himself.

Three hypodermic injections, each of the sixtieth of a grain of strychnia, were given during the ensuing week, and, as none of the peculiar symptoms were excited that would have indicated an organic disease of the cord, the patient was brought before the class in attendance at the Bellevue Hospital Medical College, and lectured upon by Dr. Hammond, as an example of reflex paraplegia. Dr. H. also coincided in the treatment adopted, and suggested that it be given a full and fair trial.

The fourth and all subsequent injections were increased to the thirtieth of a grain. There was a well-marked feeling of heat excited in both lower extremities by each dose, and fibrillary contractions were occasionally produced in the muscles on the front of the thigh. No decided improvement was observed until the 10th of November, after eight injections had been given. He then said that he could walk without having to keep his eyes fixed on the ground, that he did not trip as much as formerly, and that he could get his toes over slight impediments on the pavement with greater ease. He remained under treatment until the 17th, and received four more injections. November 20th, was again brought before the medical class, to show the effects of treatment, and then discharged perfectly well, and able to resume his business.

CASE VI.—J. W., Ireland, blacksmith, aged thirty-

four. In August, 1868, fell and cut his head. This healed readily, but in September he was attacked with erysipelas, making its appearance first at the cicatrix of the wound. After this disappeared, a scaly skin-disease came out over his body and extremities, and at the same time he became subject to attacks of vertigo, which would come on several times a day. In April, 1869, the skin-disease was cured, but the vertiginous symptoms grew worse. In August, a sense of simple muscular weakness came in the right leg, and the vertigo disappeared. The weakness in the leg gradually increased, and in November extended to the muscles of the thigh. At the same time he became conscious of prickling sensations in the right foot, and, from his inability to lift the toes, experienced considerable trouble in walking.

December 7, 1869, he came under my care in the following condition: He cannot walk without a cane, and when sitting down cannot extend or flex the right leg without assisting its movements with his hand. The muscles have not atrophied perceptibly, and respond readily to the induced current, but with less force than the corresponding ones of the other limb. The tactile sensibility is considerably impaired, but painful impressions are recognized as easily as on the other leg. The urine is acid in reaction. He states that he has had no unusual sensation about the abdomen, no cramps in the leg, and no feeling of heat in the ball of the foot. Of late there has been some trouble in retaining the urine.

December 14th, one-sixtieth of a grain of strychnia administered hypodermically.

This injection was followed by symptoms that left no doubt as to the diagnosis. During the night fol-

lowing he was attacked with pain in the back, cramps in the calves of both legs, burning sensations in the soles of both feet, and upon falling asleep was awakened by the jumping of his legs. When I next saw him, the feeling of weakness had extended to the previously-sound limb; there was a sense of constriction about the abdomen, and the urine alkaline. Both lower extremities were the seat of formication and other referred sensations, and pain in the back and cramps in the legs were prominent symptoms. No more strychnia was given, but he was ordered tr. ergot, in drachm-doses, with ten minims tr. belladonna three times a day.

February 14, 1870.—Since last date, has continued the ergot and belladonna treatment, with the effect of dissipating the symptoms excited by the strychnia. He is able to work at his business, and his paralysis is less marked than at the time he first came under my observation.

CASE VII.—II. R., Oswego County, N. Y., farmer, aged forty-nine, came under treatment in April, 1869. At that time he stated that his lower extremities had been weak and numb for three years, and that these feelings came on shortly after an attack of urethral inflammation. The only positive symptoms present were muscular weakness, slight anæsthesia, and tremulousness of the muscles. In walking, the toes dragged, and he required the assistance of two canes. Could walk short distances only, and then complained of great fatigue. No pain in back. Urine, alkaline. The degree of paralysis varies from month to month, and these fluctuations are accompanied by changes in the urine, which, during the intervals of improvement, loses its strong odor and becomes clear.

An injection of one-sixtieth of a grain of strychnia was administered as a diagnostic test. The phenomena it excited were incontinence of urine, pain in the back, spasms of the legs, especially at night, feeling of constriction about the abdomen, burning in the feet, and increased amesthesia. These symptoms persisted for several days, and then gradually yielded to the ergot and belladonna treatment to which he was subjected. He remained in the city one month, and at the end of that time was able to walk from Twenty-second to Fifty-first Street, without unusual fatigue. When last seen he still used his canes, but his power of walking had greatly improved; he was able to retain his urine, and the unpleasant symptoms excited by the strychnia-injections, four weeks previously, had entirely subsided.

CASE VIII.—M. H., Ireland, laborer, aged thirty-five. Presented himself at the Out-door Department of Bellevue Hospital, July 30, 1869, complaining of loss of power in right wrist, of six weeks' duration, which had been steadily growing worse. The arm was as well as its fellow until about the middle of June, when something happened to it one night, and since then it has been in its present condition. He cannot fix the exact date of its occurrence, having been on a prolonged spree about that time, but, as nearly as he remembers, on waking in the morning, after passing the night in a lumber-yard, at the eastern foot of Thirty-first Street, he found the arm numb and powerless. He paid little attention to the circumstance, and continued his debauch. He has been unable to work since. Liniment and other external applications have been freely used, and he is quite anxious to get well.

He cannot extend the hand, fingers, or thumb, or

move the wrist laterally. The power of making firm pressure is unimpaired, but he experiences considerable trouble in picking up small objects, or in using his tools, from his inability to completely open the hand. The sensibility to pain and tactile impressions appears to be somewhat impaired on the dorsal surface of the thumb and first two fingers. Electro-muscular contractility is much reduced in the extensor communis digitorum and extensor carpi ulnaris, and, upon comparing the two arms, it is evident that those muscles have become somewhat atrophied.

This patient not only received hypodermic injections of strychnia, but had the induced current applied to the affected muscles three times a week. It is, of course, impossible to say what was the therapeutical efficacy of the strychnia, with as much precision as if the electricity had not been employed, but certain features of the case are interesting as showing the physiological action of this drug, when used in the manner indicated.

Nine injections, each of the thirtieth of a grain, were given. He called at my office three times a week, on Monday, Wednesday, and Friday; received a hypodermic injection, and had the induced current applied to the wasted muscles. The electricity was never used to exceed five minutes at one sitting.

The first injection was followed by no well-defined symptoms. After the second, he said that, during the afternoon of the day on which it was given, his face became so flushed that an acquaintance accused him of drinking, and that the paralyzed limb was the seat of a burning sensation, especially marked on the back of the index-finger. Slight exertion was followed by profuse perspirations, and he imagined that the medi-

cine was going to weaken him greatly. About the time he received the fifth injection, the lower jaw became tremulous, and he complained very much of neuralgic pains in the right forearm. The affection of the jaw would come on in a few moments after the injection, and last about an hour. The electricity, appearing to aggravate the neuralgic pains, was suspended after six applications, and the strychnia alone used. Decided jerkings of *extensor communis digitorum* made their appearance early in the treatment, and could be easily excited by pressing the body of the muscle between the fingers. The extensor muscles gradually resumed their functions, and after the ninth injection he returned to his ordinary occupation—that of a day-laborer.

The muscles had not regained their normal size at this time, but, as I was compelled to leave the city for several weeks, the treatment was necessarily suspended. When I next saw him in October, 1869, he stated that he had been constantly at work, and had experienced no trouble from the arm. The hollow formerly apparent at the site of the atrophied muscles was no longer perceptible, and the right arm was as powerful as ever. No other or further treatment was resorted to after he passed from under my observation.

CASE IX.—J. C., Ireland, teamster, aged twenty-nine. Fell from his wagon one morning during holiday-week, 1869, and struck upon the point of his left shoulder. The whole limb was stiff and painful during the remainder of the day, but he still had sufficient control over its movements to attend to his business. The next morning, however, he found that the shoulder-joint was exceedingly tender, and that the least motion of the arm caused him great pain. For the ensuing

week he remained in his room and applied liniments to the part. January 5, 1870, applied at the Out-door Department of Bellevue Hospital. No evidences of synovitis; the arm could be carried backward or forward, but could not be abducted; no anæsthesia, and no subcutaneous ecchymosis; manipulation of the part did not cause pain. January 7th.—The deltoid responds to electricity, but not so readily as its fellow. A hypodermic injection of one-thirtieth of a grain of strychnia administered to-day. January 10th.—Says that he is confident there is less stiffness and more power in the left shoulder. The injection caused no unpleasant feelings. Injection repeated.

The patient passed from under my observation at this time, and was not again seen for several weeks. He then said that, immediately after the last injection was received, he felt well-marked jerking in the left arm, and some stiffness of the jaws, but that these symptoms passed away in an hour or so. An opportunity offering, he resumed work, and experienced but little inconvenience from his arm. At the present time (February 11th), the left shoulder is as sound as the right, and he can abduct the arm with ease.

CASE X.—F. B., U. S., laundress, aged thirty four. After working unusually hard in the hot, moist air of the laundry-room, she was exposed for a length of time to a cold wind while hanging out the clothes. That night she was restless, and had something like neuralgia of the face; in the morning she noticed a queer expression about her countenance, which attracted so many comments from her acquaintances that she became alarmed, and came to the Out-door Department of Bellevue Hospital that same afternoon.

January 14, 1870.—The right eye remains partly

open, even during forcible efforts at winking; the upper lid is drawn up, the lower depressed and everted. She cannot laugh or frown on the right side of her face; the muscles of expression are all implicated. The angle of the mouth droops on the right side, and is somewhat elevated on the left. The whole right side is smooth and devoid of expression, while the left appears unusually corrugated. She cannot purse up her lips in the manner required for whistling; the right cheek flaps in and out with forced respiratory movements. The tongue can be protruded in a straight line, and the eye can be made to perform all its natural motions. All the facial muscles responded naturally to the induced current; no anesthesia; no trouble with speech.

A hypodermic injection of one-twentieth of a grain of strychnia was given on the 17th, and repeated on the 19th and 21st of January. Each injection was followed by twitching of the paralyzed side of the face, and well-marked rigidity of the masseter muscles. By the end of a week, the paralysis had disappeared.

The phenomena which result from the immediate effects of the strychnia upon the system, when introduced directly into the circulating fluid by hypodermic injection, have been dwelt upon at length in the articles of Mr. Hunter and Dr. Echeverria. In the cases recorded by the former, the most prominent effects were a general glow and warmth of the cutaneous surface, with temporary accession of power in the weakened muscles. In some cases, diaphoresis accompanied the feeling of warmth; and, like the latter, was most marked in the paralyzed limbs. In each of Dr. Echeverria's carefully-observed cases, some of the

following phenomena were noticed: increased power and sensibility in the diseased parts; acceleration of pulse and respiration, and augmentation of temperature; giddiness; dilatation of pupils; gurgling of the bowels; fibrillary contractions; trismus; peculiar countenance; sighing, and congestion of the face.

In the foregoing cases, all the symptoms noticed by the patients were carefully recorded, and they differ widely on the three divisions of hemiplegia, paraplegia, and local paralysis.

In all the cases of hemiplegia there was progressive improvement in the muscular power.

In two cases, a feeling of warmth in the paralyzed limbs was especially marked. In both cases, in addition to loss of muscular power, there was anaesthesia.

Jerking of the muscles and fibrillary contractions were excited in two cases; and in one case, rigidity of the lower jaw.

In one case a sensation of tingling and smarting was observed whenever the needle was inserted beneath the skin of the diseased side.

In Case III., there was gradual improvement and ultimate cure, without any other symptom that could be ascribed to the effects of the strychnia.

The phenomena produced in the cases of paraplegia could doubtless have been excited by the internal administration of the drug, had it been given in sufficiently large doses, and for a length of time. This is certainly true as regards two cases, in which the symptoms of organic disease of the cord were excited in each instance by a single hypodermic injection. In the case of functional disorder, a feeling of heat, corresponding in situation to the extent of the preceding anaesthesia, together with fibrillary contraction of the paralyzed muscles, were the only symptoms noticed.

The cases of local paralysis exhibited certain phenomena that were not presented by either of the other forms of paralysis. The tremulousness of the lower jaw and spasm of the masseter muscles were doubtless effects of the same cause, operating with greater intensity in one case than in the other. The increased tonicity of the muscles, due to the immediate effects of the remedy, was manifested by contraction, more or less persistent, thus giving rise to spasm, or by irregular muscular action producing the peculiar phenomena of tremor. The flushing of the face and diaphoresis, in Case VIII., if due to the strychnia, are to be ascribed to its implication of the sympathetic nervous system, and are among the rarer manifestations of the action of this remedy.

Before considering the results obtained in the foregoing cases, I will introduce brief notes of thirteen cases of hemiplegia, treated by the hypodermic injection of strychnia, occurring in the private practice of Dr. William A. Hammond in 1865, and to whom I am indebted for permission to use them in this connection. The date affixed to each case indicates the time it came under treatment; and it will be seen that Dr. Hammond was in the habit of employing this method of administering strychnia several years before the appearance of Mr. Hunter's paper:

CASE I.—H. A., fifty; male: right hemiplegia; January, 1865; strychnia ineffectual by the stomach; thirteen injections; much improved.

CASE II.—J. S., forty-two; male: left hemiplegia; February, 1865; thirteen injections; much improved.

CASE III.—S. T., sixty; female: right hemiplegia; February, 1865; strychnia ineffectual by the stomach; nine injections; much improved.

CASE IV.—J. S., sixty; female: right hemiplegia; April, 1865; five injections; much improved.

CASE V.—M. T., fifty-two; male: right hemiplegia; April 21, 1865; strychnia ineffectual by the stomach; eleven injections; cured.

CASE VI.—O. S., sixty-three, female: left hemiplegia; April 30, 1865; secondary contractions; twenty-two injections; no improvement.

CASE VII.—B. R., forty-seven; male: left hemiplegia; June 11, 1865; strychnia ineffectual by the stomach; seven injections; much improved.

CASE VIII.—R. F., fifty; male: left hemiplegia; July 17, 1865; strychnia, ineffectual by the stomach; eight injections; cured.

CASE IX.—T. W., forty-eight; male: left hemiplegia; September 5, 1865; eight injections; much improved.

CASE X.—T. S., forty-nine; male: left hemiplegia; September 7, 1865; secondary contractions, five injections; no improvement.

CASE XI.—J. J., fifty-seven; male: left hemiplegia; September 10, 1865; secondary contractions; no improvement.

CASE XII.—J. W., fifty-two; male: right hemiplegia; affecting arm only at the time treatment commenced; September 27, 1865; strychnia ineffectual internally; six injections; cured.

CASE XIII.—W. M., forty-five; male; left hemiplegia; October 19, 1865; strychnia ineffectual internally; seven injections; cured.

All but three of the above thirteen cases were either greatly improved or completely cured.

Of the ten cases greatly improved or completely cured, seven had previously taken strychnia internally

without effect. Of this number, four were completely cured.

In three cases in which no improvement was manifested, the muscles had undergone the change known as "secondary contraction."

The conclusion to be drawn from a consideration of the foregoing examples of hemiplegia is, that in the hypodermic injection of strychnia we possess a remedy of great power and usefulness, and that no case should be pronounced incurable until it has been fully and fairly tested. The only instances in which no result of a favorable character was obtained, were those cases in which the muscles became permanently contracted and shortened at a late period after the first manifestation of the disease—that variety designated by Todd as hemiplegia with late rigidity, in contradistinction to those in which this phenomenon was an early manifestation. The former, he imagined to depend upon the contraction of the cicatrix resulting from reunion of cerebral fibres ruptured by a former apoplectic extravasation; the latter, from an irritated condition of the motor filaments in the immediate vicinity of a cerebral lesion. However correct he may have been in the latter surmise, modern investigation (especially the researches of M. Charles Bouchard, whose monograph on that subject has recently been translated by Dr. Hum, of Albany) would appear to indicate that the sclerosis following secondary degeneration of the spinal cord, subsequent to cerebral lesions, is an important, if not the sole cause of those muscular changes that form the basis of this classification.

Cases of hemiplegia present themselves in one of three conditions as regards the state of the muscles of

the paralyzed limbs; and these conditions are valuable aids to a correct prognosis. In one class of cases, of which Case II. is an example, there may simply be motor paralysis, and the character of the deformity and mode of progression is such as results from a want of voluntary muscular power. In these cases, the patient is unable to dress or feed himself; or, depending upon the extent of the paralysis, to perform any of the simple movements so constantly used in executing the ordinary offices of daily life. He cannot bend his arm, flex his fingers, or elevate his toes, simply because his volitional impulses cannot act upon the muscles, the contraction of which is essential to the execution of these movements, and a process of atrophy is the result of their forced inaction. In these cases the arm hangs uselessly by the side, and the lower extremity is of but little aid in walking.

In another variety of cases, the arm and leg are paralyzed, and, from the preponderating influence of the flexor muscles, assume certain positions that are common to this and the remaining class. In these cases, however, although the fingers, wrist, and forearm, are flexed, yet they can be readily straightened by the application of a slight amount of power, and this circumstance is the diagnostic mark between the two divisions. Case I. is an example.

The third class of cases are examples of what is known as "secondary contractions." The extensor muscles, especially of the arm, are completely paralyzed, and the flexors are shortened and rigid. The shoulder is elevated from changes in the levator anguli scapulæ; the arm is adducted and rotated inward; the forearm midway between pronation and supination and the hand and fingers strongly flexed—the latter in

some cases to such a degree as to cause injury to the palm from pressure of the nails. The hamstring muscles may be the only ones affected in the lower extremity, and can be felt as hard cords beneath the integument, extending from their origin to their insertion. The diagnostic mark between this and the preceding variety is, that no reasonable amount of force is sufficient to overcome these contractions, and restore the limbs to their normal position. The three cases in Dr. Hammond's series, which were not benefited by treatment, belonged to this class.

Cases of hemiplegia, belonging to either of the first two classes, are susceptible of relief from the hypodermic injection of strychnia. A favorable prognosis can be given in any case in which the limbs have not undergone these secondary contractions, and, as is evident from the foregoing examples, the fact that strychnia internally has been of no avail, does not argue against its efficacy when administered hypodermically.

Cases of paraplegia which do not present evidences of organic disease of the cord, of which Case V. is an example, are very favorable for this method of treatment. It is not too much to say that any case of paralysis of the lower extremities, in which the diagnosis between organic and functional disease is doubtful, should be subjected to the test of a hypodermic injection of strychnia. The amount of the remedy used should be small, and its effects closely watched. If there is any organic disease existing, its presence will be manifested by some of the symptoms detailed in Cases VI. and VII., and their advent will indicate the necessity for a different course of treatment. Should nothing of the kind be elicited, then the hypodermic injections can be proceeded with either alone, or as an adjunct to other therapeutical measures.

In the cases of local paralysis above related, the hypodermic injections were certainly of benefit. In the greater number of instances, however, the use of electricity is equally efficacious in its results, and is free from many of the objections which can be urged against the former method. In those cases in which, from any cause, electricity is contraindicated, hypodermic injection of strychnia is the next best resource.

The advantages of this method of administering strychnia are:

1. Quantity required.

A reference to the details of the preceding cases will show that an amount of the remedy which would be considered insignificant, administered internally, has been sufficient to produce the best results.

2. Speed of action.

In Case IV. this was very evident; but it is not usual to see such rapid improvement. In this respect Case I. is a better example. As has been remarked by Mr. Hunter, a case that is susceptible of relief will respond readily to this method of treatment, and but a small number of injections are requisite to determine whether any improvement can be effected in a given case. This is not an absolute rule, however; for, in Case V., treatment was continued three weeks, and eight hypodermic injections administered, before any amendment was manifested.

3. Greater efficacy.

In Case II., the patient had previously taken strychnia internally, without effect. The same fact is noted in seven of Dr. Hammond's cases; yet four of these eight cases were completely cured, and four greatly improved.

In addition to the advantages arising from the

small quantity required, its speedy action and greater efficacy, the power it possesses of unmasking organic disease of the cord, in doubtful cases, makes it a valuable diagnostic aid in certain cases of paraplegia.

Too great care cannot be exercised upon the solution intended for subcutaneous injection. Aside from securing a trustworthy article, strict attention should be given to the strength of the solution, so that a given number of drops shall correspond to a definite amount of strychnia. Unfortunately, the hypodermic syringes in general use are not graduated alike, so that a standard solution, applicable to all cases, is not practicable. However, if the following plan is adopted, the inconveniences, otherwise unavoidable, are done away with: Each physician should make his own solution. This is readily and accurately done by taking a certain quantity of water, enough to fill the syringe twenty times, and adding to it four grains of strychnia dissolved in two drops of dilute phosphoric acid. Each syringe-full will then contain one-fifth of a grain; one-half full, one-tenth of a grain; one-quarter full, one-twentieth of a grain; one-eighth full, one-fortieth of a grain, etc. In this manner a reliable solution is formed—one, the strength of which can never be mistaken. The only objection is, that it must be administered with the instrument for which it was calculated.

The solution made with dilute phosphoric acid is better than with sulphuric acid. With the former, a smaller quantity is required to dissolve the strychnia, and the solution, upon standing, does not become filled with flocculi, as in the latter case.

No stated quantity will serve as a dose in all instances, and in this respect each case will require separate study. For an adult, it is perfectly safe to admin-

ister as much as the one-tenth of a grain; but so large a dose is rarely necessary. The safest plan is to commence with a minimum quantity—say, the sixtieth of a grain—and increase it gradually as the patient becomes accustomed to the effects of the drug and the necessities of the case require.

A grave objection to hypodermic medication, and one that is of great weight with many practitioners, is the danger of abscesses forming at the point where the solution is thrown into the cellular tissue. I have seen this accident follow the use of morphia, and have known of its occurrence after hypodermic injections of chloral; yet, although my experience with strychnia employed in this manner has been quite extensive, I have never seen any thing of the kind result from its use. I am of the opinion that a concentrated solution, of which it is necessary to use but a small quantity, is less liable to cause this accident than one requiring the introduction of a larger amount of liquid.

This method of treatment is far from being applicable to all forms of paralysis. Its employment in cases of organic disease of the spinal cord, such as meningitis, myelitis, congestion of the cord or tumors, is radically wrong, and can result in nothing but injury to the patient. Cases of paraplegia not due to organic disease are the only examples of that form of paralysis in which strychnia should be used in any form; and in such cases, if the hypodermic injections are not sufficient for a cure, they will always be found a useful adjunct to other methods of treatment.

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